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ComEd Multifamily Energy Savings Program Impact Evaluation Report

Energy Efficiency / Demand Response Plan: Plan Year 9 (PY9)

Presented to
ComEd

FINAL

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ComEd Multifamily Energy Savings Program Impact Evaluation Report

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1. INTRODUCTION

This report presents the results of the impact evaluation of ComEd's Program Year 9 (PY9) Multifamily Energy Savings Program (MESP). It presents a summary of the energy and demand impacts for the total program and details broken out by relevant measure and program structure. The appendix presents the impact analysis methodology. PY9 covers June 1, 2016 through December 31, 2017.

The MESP was jointly implemented by: ComEd, Nicor Gas Company, Peoples Gas (PGL), and North Shore Gas (NSG) companies.[1] The EPY9/GPY6 ComEd/Nicor Gas joint program was implemented by CLEAResult, and the ComEd/PGL/NSG program was implemented by Franklin Energy Services.

2. PROGRAM DESCRIPTION

In PY9, the program provided assessment services and free direct install tenant space measures such as water efficient aerators, showerheads, programmable thermostats, and CFL lighting measures. In addition, the PY9 program introduced new direct install specialty LEDs to replace CFLs (which were phased out from PY9 onwards[2]) and advanced power strips.

The program had 1,540 participants in PY9 and distributed 164,740 measures as shown in the following table and graph. Light Emitting Diode (LED) bulbs comprised of 64 percent of the measure mix, followed by compact fluorescent lamps (CFL), which contributed 33 percent of the total measures. Programmable and reprogrammed thermostats represented two percent of the measures installed, and the remaining one percent came from faucet aerators, domestic hot water (DHW) pipe insulation, low flow showerheads, and advanced power strips. Faucet aerators, DWH pipe insulation, and low flow showerheads save energy by reducing the amount of electricity needed to produce hot water.

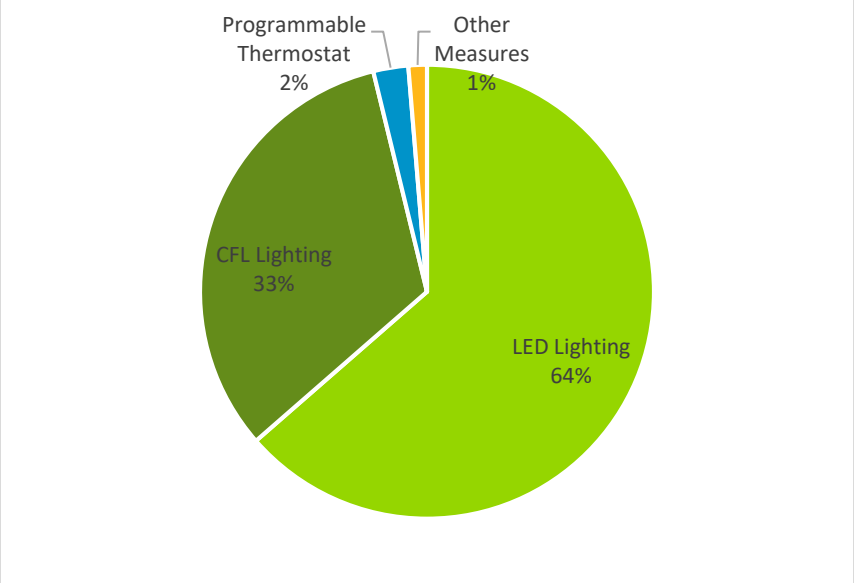
Table 2-1. PY9 Volumetric Findings Detail

Participation	CLEAResult	Franklin Energy	Total
Participants*	121	1,419	1,540
Total Measures	78,140	86,600	164,740
Number of Projects	528	11,952	12,480

* Participants comprise of property addresses (covering 21,683 tenant apartments)
Source: ComEd tracking data and Navigant team analysis.

[1] The current program years are electric program year 9 (EPY9) and gas program year 6 (GPY6).
[2] EPY9 is a transition year from CFLs to LEDs. Standard wattage CFLs were still installed during EPY9 from June 2016 to June 2017. After June 2017, no more CFLs were installed and the predominant lighting measure was LEDs.

Figure 2-1. Number of Measures Installed by Type



Source: Evaluation Analysis

3. Program Savings

Table 3-1 summarizes the incremental energy and demand savings the Multifamily Energy Savings Program achieved in PY9.

Table 3-1. PY9 Total Annual Incremental Savings

Savings Category	Energy Savings (kWh)	Demand Savings (kW)	Peak Demand Savings (kW)
Ex Ante Gross Savings	5,665,053	NA	NA
Program Gross Realization Rate	100%	NA	NA
Verified Gross Savings	5,665,327	7,718	551
Program Net-to-Gross Ratio (NTGR)*	Varies	Varies	Varies
Verified Net Savings	5,491,494	7,503	538

* NTGR varies by measure type. Details are provided in the next section of the report.
Source: ComEd tracking data and Navigant team analysis.

4. Program Savings by Measure

The following tables show program electric and demand savings by measure. The program included eight types of measures. LED and CFL lighting contributed the most savings, representing 83 percent of verified gross kWh and KW savings (60 percent from LEDs and 23 percent from CFLs). Thermostat measures contributed 10 percent, and the advanced power strips contributed two percent. The remaining three percent came from faucet aerators, domestic hot water (DHW) pipe insulation, and low flow showerheads.

Table 4-1. PY9 Energy Savings by Measure

End Use Type	Research Category	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTGR *	Verified Net Savings (kWh)	Technical Measure Life	Persistence	Effective Useful Life (EUL)†
Lighting	LED Lighting	3,427,283	100%	3,428,318	0.98	3,359,751	NA	NA	10
Lighting	CFL Lighting	1,314,014	100%	1,313,437	0.98	1,287,168	NA	NA	4
HVAC	Programmable	568,517	100%	568,295	0.90	511,466	NA	NA	5
HVAC	Reprogram Thermostat	8,236	100%	8,272	0.90	7,445	NA	NA	2
Advanced Power Strip (APS)	APS (Tier 1)	51,191	100%	51,191	0.95	48,631	NA	NA	4
Advanced Power Strip (APS)	APS (Tier 2)	78,120	100%	78,120	0.95	74,214	NA	NA	7
Hot Water	Showerhead	173,800	100%	173,801	0.92	159,897	NA	NA	10
Hot Water	Bathroom Faucet Aerator	13,741	100%	13,741	0.94	12,917	NA	NA	9
Hot Water	Kitchen Faucet Aerator	27,221	100%	27,221	1.00	27,221	NA	NA	9
Pipe Insulation	DHW Pipe Insulation	2,931	100%	2,930	0.95	2,784	NA	NA	15
Total‡		5,665,053	100%	5,665,327		5,491,494			

* A deemed value. Source: ComEd_NTG_History_and_PY9_Recommendations_2016-02-26_Final.xlsx, which is to be found on the IL SAG web site here: http://ilsag.info/net-to-gross-framework.html.

† EUL is a combination of technical measure life and persistence.

‡ Values may not sum exactly due to rounding.

Source: ComEd tracking data and Navigant team analysis.

Table 4-2. PY9 Demand Savings by Measure

End Use Type	Research Category	Ex Ante Gross Demand Reduction (kW)*	Verified Gross Realization Rate	Verified Gross Demand Reduction (kW)	NTGR†	Verified Net Demand Reduction (kW)
Lighting	LED Lighting	NR	NA	4,311	0.98	4,225
Lighting	CFL Lighting	NR	NA	1,703	0.98	1,668
HVAC	Programmable	NR	NA	0	0.90	0
HVAC	Reprogram Thermostat	NR	NA	0	0.90	0
Advanced Power Strip (APS)	APS (Tier 1)	NR	NA	7	0.95	7
Advanced Power Strip (APS)	APS (Tier 2)	NR	NA	18	0.95	17
Hot Water	Showerhead	NR	NA	701	0.92	645
Hot Water	Bathroom Faucet Aerator	NR	NA	625	0.94	587
Hot Water	Kitchen Faucet Aerator	NR	NA	354	1.00	354
Pipe Insulation	DHW Pipe Insulation	NR	NA	0	0.95	0
Total‡		NR	NA	7,718		7,503

* NR = not reported; the implementation contractors did not report ex ante demand savings in the tracking data.

† A deemed value. Source: ComEd_NTG_History_and_PY9_Recommendations_2016-02-26_Final.xlsx, which is to be found on the IL SAG web site here: http://ilsag.info/net-to-gross-framework.html.

‡ Values may not sum exactly due to rounding.

Source: ComEd tracking data and Navigant team analysis.

Table 4-3. PY9 Peak Demand Savings by Measure

End Use Type	Research Category	Ex Ante Gross Peak Demand Reduction (kW)*	Verified Gross Realization Rate	Verified Gross Peak Demand Reduction (kW)	NTGR†	Verified Peak Net Demand Reduction (kW)
Lighting	LED Lighting	NR	NA	364	0.98	357
Lighting	CFL Lighting	NR	NA	126	0.98	124
HVAC	Programmable	NR	NA	0	0.90	0
HVAC	Reprogram Thermostat	NR	NA	0	0.90	0
Advanced Power Strip (APS)	APS (Tier 1)	NR	NA	6	0.95	5
Advanced Power Strip (APS)	APS (Tier 2)	NR	NA	14	0.95	14
Hot Water	Showerhead	NR	NA	19	0.92	18
Hot Water	Bathroom Faucet Aerator	NR	NA	14	0.94	13
Hot Water	Kitchen Faucet Aerator	NR	NA	8	1.00	8
Pipe Insulation	DHW Pipe Insulation	NR	NA	0	0.95	0
Total‡		NR	NA	551		538

* NR = not reported; the implementation contractors did not report ex ante peak demand savings in the tracking data.
† A deemed value. Source: ComEd_NTG_History_and_PY9_Recommendations_2016-02-26_Final.xlsx, which is to be found on the IL SAG web site here: http://ilsag.info/net-to-gross-framework.html.
‡ Values may not sum exactly due to rounding.
Source: ComEd tracking data and Navigant team analysis.

5. Impact Analysis Findings and Recommendations

5.1 Impact Parameter Estimates

Navigant estimated verified unit savings for each program measure using impact algorithm sources found in the version 5 of the Illinois Technical Reference Manual[3] (TRM v5.0) presents the key parameters and the references used in the verified gross and net savings calculations. Detailed breakdown of the measure quantities and per unit savings values are provided in the appendix.

Table 5-1. Verified Gross Savings Parameters

Gross Savings Input Parameters	Value	Deemed* or Evaluated?
Measure Quantities	Varies	Evaluated
Measure Type and Eligibility	Varies	Deemed
Savings Input Assumptions	Varies	Deemed
Gross Savings per Unit	Varies	Deemed
Verified Realization Rate on Ex Ante Gross Savings	Varies	Evaluated
NTGR†	Varies	Deemed

* Illinois Statewide Technical Reference Manual for Energy Efficiency Version 5.0, available at: http://www.ilsag.info/technical-reference-manual.html.
† Deemed values. Source: ComEd_NTG_History_and_PY9_Recommendations_2016-02-26_Final.xlsx, which is to be found on the IL SAG web site here: http://ilsag.info/net-to-gross-framework.html.

[3] Illinois Statewide Technical Reference Manual for Energy Efficiency Version 5.0, available at: http://www.ilsag.info/technical-reference-manual.html

5.2 Other Impact Findings and Recommendations

Navigant reviewed the tracking data and for quality and completeness and verified the savings for the program.

Finding 1. Navigant verified that Franklin Energy used 4.7W LED (Candelabra) replacing 40W incandescent according to the measure specification sheet, although the measure description in the tracking data was 5W LED. The verified per unit savings was 42.33 kWh, consistent with the TRM v5.0. Evaluation applied additional minor rounding adjustment to the LED and CFL savings, resulting in verified savings of 2,225 kWh, 2 MWh less than the ex ante savings.

Recommendation 1: Ensure that measure descriptions in the tracking data are consistent with TRM assumptions used to derive savings.

Finding 2. Some households (31 records) received more than one programmable thermostat (furnace), and implementers credited savings for each installed thermostat (example projects include #1430159, #1744401, and #1430163). The TRM (v5.0) states "installation of multiple programable thermostats per home does not accrue additional savings." A sample of project IDs are listed above, and a full list is included in Appendix 2.

Recommendation 2: Savings for programmable thermostat measures should be capped at one unit per household.

Finding 3. The implementation contractors did not track demand savings.

Recommendation 3: Navigant recommends that the implementation contractors track and report demand savings for this program in the future.

6. Appendix 1. Impact Analysis Methodology

6.1 Verified Gross Program Savings Analysis Approach

Navigant determined verified gross savings for each program measure by:

1. Reviewing the savings algorithm inputs in the measure workbook for agreement with the TRM v 5.0.
2. Validating that the savings algorithm was applied correctly.
3. Cross-checking per-unit savings values in the tracking data with the verified values in the measure workbook or in Navigant's calculations if the workbook did not agree with the TRM.
4. Multiplying the verified per-unit savings value by the quantity reported in the tracking data.

6.2 Verified Net Program Savings Analysis Approach

Navigant calculated verified net energy and demand (coincident peak and overall) savings by multiplying the verified gross savings estimates by a net-to-gross ratio (NTGR). In PY9, the NTGR estimates used to calculate the net verified savings were based on past evaluation research and defined by a consensus process through SAG, as documented in a spreadsheet.[4]

[4] Source ComEd_NTG_History_and_PY9_Recommendations_2016-02-26_Final.xlsx, which is to be found on the IL SAG web site here: http://ilsag.info/net-to-gross-framework.html

7. APPENDIX 2. IMPACT ANALYSIS DETAIL

Navigant downloaded the final tracking data and measure workbook for the MFES PY9 impact evaluation from the ComEd Evaluation Share file site. We relied on the following documents to verify the per-unit savings for each program measure:

- Final PY9 tracking database file: "Multifamily_PY9_EOY_Evaluation_Data_Rev0_01172018.xlsx".
- Illinois Technical Reference Manual (TRM v5.0) for deemed input parameters or secondary evaluation research to verify any custom inputs used in the ex ante calculations.
- Measure Workbook ("PY9 DI Savings Values per TRM- 9.8.2016")

The following sections provide an outline of the differences between the ex ante and verified savings estimates for each measure by end-use. Each section contains a table that provides the quantity installed[5], ex ante and ex post values, and realization rates. Note that these values are reported in kWh, as opposed to MWh which are used for reporting in the above sections.

7.1 Lighting

LED and CFL lighting includes interior and exterior screw-based bulbs that replaced higher wattage incandescent or halogen bulbs. The program installed 158,343 bulbs including 104,671 LED bulbs and 53,672 CFL bulbs. Lighting savings were adjusted 2,225 kWh less due to adjustment to per unit savings values as shown in the table below, but had an overall realization rate of 100 percent. Lighting contributed 83 percent of the overall verified savings.

[5] This quantity represents the values provided in the tracking data and are not grouped by unit as shown in Table 2-1.

Table 7-1. Lighting Measures Impact Detail

Measure	Units Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
9W CFL	Lamp	89	16.00	100%	15.98
13W CFL	Lamp	50,692	23.97 or 24.0	100%	23.97
18W CFL	Lamp	1,476	27.97 or 28	100%	27.97
23W CFL	Lamp	1,415	39.16 or 39.20	100%	39.16
15W LED (Exterior)	Lamp	31	136.70	100%	136.70
15W LED	Lamp	7	43.60	100%	43.60
4.5W LED (Globe)	Lamp	14,939	29.30	100%	29.30
4.7W LED (Candelabra)	Lamp	1,693	42.30 or 42.33	100%	42.33
5W LED (Candelabra)	Lamp	13,019	41.97	99%	41.97
5W LED (Candelabra, Exterior)	Lamp	10	83.94	100%	83.94
6W LED (Globe)	Lamp	20,221	28.30	100%	28.33
7W LED (Track)	Lamp	9,664	37.31	100%	37.31
8W LED (Flood)	Lamp	2,959	49.46	100%	49.46
8W LED (Flood, Exterior)	Lamp	21	136.70	100%	136.70
9W LED (Exterior)	Lamp	2,073	81.54	100%	81.54
11W LED (A-Line)	Lamp	11	32.13	100%	32.13
11W LED	Lamp	9	32.10 or 32.13	100%	32.13
7W LED (MR16)	Lamp	4,631	37.31	100%	37.31
9.5W LED (BR30)	Lamp	1,254	48.16	100%	48.16
11W LED (A-Line, Exterior)	Lamp	7	100.73	100%	100.73
13 W LED (Exterior)	Lamp	236	95.93	100%	95.93
16W LED (A-Line)	Lamp	96	42.83	100%	42.83
16W LED (A-Line, Exterior)	Lamp	7	134.30	100%	134.30
5.5W LED (A-Line)	Lamp	701	17.97	100%	17.97
5.5W LED (A-Line, Exterior)	Lamp	89	56.36	100%	56.36
6W LED	Lamp	1,721	17.60	100%	17.59
9W LED	Lamp	15,214	26.00	100%	26.01
5W LED (Candelabra, Globe)	Lamp	19	41.97	100%	41.97
5W LED (Globe)	Lamp	5,049	22.54	100%	22.54
6.5W LED (GU10)	Lamp	105	37.74	100%	37.74
6.5W LED (MR16)	Lamp	11	37.74	100%	37.74
8W LED (BR30) Interior	Lamp	484	36.44	100%	36.44
9W LED (A-Line)	Lamp	10,389	26.01	100%	26.01
8W LED (BR30) Exterior	Lamp	1	100.73	100%	100.73

Source: ComEd tracking data and Navigant team analysis.

7.2 Programmable Thermostats

Navigant slightly increased the per unit savings values from programmable thermostats due to rounding errors. Also, 31 tenant records received more than one thermostat and the verified savings was limited to one household per thermostats, according to the TRM. These adjustments reduced the thermostats savings by 186 kWh, but had an overall realization rate of 100 percent. Programmable and reprogrammed thermostats contributed 10 percent of the energy savings.

Table 7-2. Programmable Thermostats Measures Impact Detail

Measure	Units Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
Joint T-Stat	Each	2,476	37.05	101%	37.26
Prog. T-Stat - Electric - Heat Pump	Each	308	492.05	100%	492.39
Prog. T-Stat - Electric - Resist. Heat	Each	356	836.55	100%	837.07
Prog. T-Stat - Gas - Furnace	Each	739	37.10	100%	37.26
RE-Prog. T-Stat - Gas - Furnace	Each	222	37.10	100%	37.26

Source: ComEd tracking data and Navigant team analysis.

A complete list of project IDs that had more than one programmable thermostat are listed below.

Table 7-3. Project IDs with Multiple Thermostats per Household

Project IDs		
PRJ-1336837	1430168	1430148
1512440	1430159	1430149
1430146	1430176	1430169
1430174	1430162	1432345
1430161	1430154	1432347
1430158	1430163	1432349
1430177	1430153	1432353
1430179	1430139	1902847
1430173	1430155	1744376
1430141	1430186	1744401
1430175		

Source: ComEd tracking data and Navigant team analysis

7.3 Showerheads

Showerheads had an overall realization rate of 100 percent and contributed to three percent of the energy savings.

Table 7-4. Showerheads Measures Impact Detail

Measure	Units Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
Showerhead	Each	484	359.09	100%	359.09

Source: ComEd tracking data and Navigant team analysis.

7.4 Advanced Power Strips

Advanced Power Strips (APS) had an overall realization rate of 100 percent and contributed to two percent of the energy savings. The program installed both Tier 1 (Tricklestar brand and Tier 2 (Embertec brand APS. The Embertec APS units have been classified as Tier 2 by the Illinois Technical Advisory Committee. The ex ante savings of 210 kWh per unit reflects Product Class B. Using the TRM v5.0 algorithm, the verified savings is:

600 kWh * 50% ERP * 0.70 ISR = 210 kWh

The savings produced by the direct install Tier 1 APS is fully deemed as 103 kWh per unit.

Table 7-5. Advanced Power Strips Measures Impact Detail

Measure	Units Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
APS - Tier 1	Each	497	103.00	100%	103.00
APS - Tier 2	Each	372	210.00	100%	210.00

Source: ComEd tracking data and Navigant team analysis.

7.5 Faucet Aerators

Faucet Aerators had an overall realization rate of 100 percent and contributed to less than one percent of the energy savings.

Table 7-6. Faucet Aerator Measures Impact Detail

Measure	Units Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
Bathroom Aerator	Each	549	25.03	100%	25.03
Kitchen Aerator	Each	265	102.72	100%	102.72

Source: ComEd tracking data and Navigant team analysis

7.6 DHW Pipe Insulation

DHW Pipe Insulation had an overall realization rate of 100 percent and contributed to less than one percent of the energy savings.

Table 7-7. DHW Pipe Insulation Measures Impact Detail

Measure	Units Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
Elec DHW Pipe Insulation	Linear Feet	129	22.72	100%	22.72

Source: ComEd tracking data and Navigant team analysis.

8. Appendix 3. Total Resource Cost Detail

Table 8-1, the Total Resource Cost (TRC) variable table, only includes cost-effectiveness analysis inputs available at the time of finalizing the PY9 MESP impact evaluation report. Additional required cost data (e.g., measure costs, program level incentive and non-incentive costs) are not included in this table and will be provided to evaluation later. EUL information in this table is subject to change and is not final.

Table 8-1. Total Resource Cost Savings Summary

End Use Type	Research Category	Units	Quantity	Effective Useful Life*	Ex Ante Gross Savings (kWh)	Ex Ante Gross Peak Demand Reduction (kW)	Verified Gross Savings (kWh)	Verified Gross Peak Demand Reduction (kW)
Lighting	LED Lighting	Lamp	104,671	10	3,427,283	NR	3,428,318	363.9
Lighting	CFL Lighting	Lamp	53,672	4	1,314,014	NR	1,313,437	126.1
HVAC	Programmable	Each	3,879	5	568,517	NR	568,295	-
HVAC	Reprogram Thermostat	Each	222	2	8,236	NR	8,272	-
Advanced Power Strip (APS)	APS (Tier 1)	Each	497	4	51,191	NR	51,191	5.7
Advanced Power Strip (APS)	APS (Tier 2)	Each	372	7	78,120	NR	78,120	14.3
Hot Water	Showerhead	Each	484	10	173,800	NR	173,801	19.5
Hot Water	Bathroom Faucet Aerator	Each	549	9	13,741	NR	13,741	13.7
Hot Water	Kitchen Faucet Aerator	Each	265	9	27,221	NR	27,221	7.8
Pipe Insulation	DHW Pipe Insulation	Ln Ft.	129	15	2,931	NR	2,930	0.4

All measures listed are direct install

*Illinois Statewide Technical Reference Manual for Energy Efficiency Version 5.0, available at: http://www.ilsag.info/technical-reference-manual.html.